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# Early stage Alzheimer detection using EEG

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**Abstract —***Alzheimer disease is a Neuro-degenerative disease, which is a common form of dementia. It is the most expensive Disease in the modern society & characterized by cognitive, intellectual as well as behavioral disturbances[1]. Due to this, early diagnosis of this disease is essential as it helps the patients and their family to take preventive measures. Also it helps to increase the life span of patients by providing proper medications if it is diagnosed during the initial stage. The only definite method of diagnosis is examination of brain tissue obtained from a biopsy or autopsy. Clinical trials for Alzheimer's disease are extremely difficult to set up in a meaningful way, because disease is only diagnosed when extensive damage to nervous system has already occurred. Various neuro imaging methods are used for the diagnosis of Alzheimer's disease. Several methods such as a single photon emission computerized tomography (SPECT), Positron emission Tomography (PET) and Magnetic Resonance imaging(MRI) have been successful for recognizing Alzheimer disease at early stage. The main problem of these methods is they impose radiation risks. Other disadvantages are their costs; which are much expensive, Time consuming & Inconvenient. So apart from all these neuro imaging methods, EEG can be used as a standard method for the Diagnosis of the Alzheimer disease during early stage. Thus EEG can be used as the inexpensive, convenient tool for diagnosis of Alzheimer disease[2].*

***Key Words*: Artificial Neural Network**

## 1. INTRODUCTION

Alzheimer's disease (AD) is regarded to be the most widespread form of dementia. Alzheimer is a neurodegenerative disease whose symptoms are the loss of memory and cognitive impairments able to affect social and occupational activities[1]. Currently, no drugs are known to cure AD and the average survival times from onset of dementia is about 4.5 years, with a peak of 11 years for younger patients (65-70 years at diagnosis). Three different phases characterize the AD progression: mild, moderate, and severe. Moreover, a preclinical stage, called Mild Cognitive Impairment (MCI), affects patients that suffer from some isolated cognitive deficit due to which they could develop AD.

Nowadays, the diagnosis requires a combination of physical, neurological, and neuropsychological evaluations, and a variety of other diagnostic tests including imaging techniques. Nevertheless, the final diagnosis can only be defined with a histopathological analysis of the brain. However, early diagnosis of potential AD is crucial for the adoption of therapeutic strategies able to slow the progression of the disease. In recent years, several studies investigated Electroencephalography (EEG) as prominent candidate for diagnosing AD. The EEG is a non-invasive recording of the electrical spontaneous activity of the brain measured at different sites of the scalp and hence the EEG signals can indirectly contain information about physiological conditions related to the brain[2].

## 2. LITERATURE STUDY ON RELATED WORK

No single test can determine whether a person has Alzheimer's disease. A diagnosis is made by determining the presence of certain symptoms and ruling out other causes of dementia. Alzheimer disease can be detected by careful medical evaluation, a thorough medical history, mental status testing, a physical and neurological exam, blood tests and brain imaging. Current diagnosis of Alzheimer disease is made by clinical, neuropsychological, and neuro imaging assessments. Several tests used for the diagnosis of Alzheimer includes

### a. MRI

Magnetic resonance imaging (MRI) is a test that uses a magnetic field and pulses of radio wave energy to make pictures of organs and structures inside the body[1]. In many cases MRI gives different information about structures in the body than can be seen with an X-ray, ultrasound, or computed tomography (CT) scan. MRI also may show problems that cannot be seen with other imaging methods. For an MRI test, the area of the body being studied is placed inside a special machine that contains a strong magnet. Pictures from an MRI scan are digital images that can be saved and stored on a computer for more study. The images also can be reviewed remotely, such as in a clinic or an operating room. In some cases, contrast material may be used during the MRI scan to show certain structures more clearly. MCI is not directly visible in MRI, MRI has to be processed to detect MCI stage.

### b. CT SCAN

CT or CAT scans are special X-ray tests that produce cross-sectional images of the body using X-ray and a computer. CT scans are also referred to as computerized axial tomography. Physicians use a CT of the brain to look for and rule out other causes of dementia, such as a brain tumour, subdural hematoma or stroke. The initial criteria for CT scan diagnosis of Alzheimer disease includes diffuse cerebral atrophy with enlargement of the cortical sulci and increased

size of ventricles. A multitude of studies indicated that cerebral atrophy is significantly greater in patients with Alzheimer disease than in patients who are aging without Alzheimer disease. Thus by using this concept the diagnosis of Alzheimer can be done by using CT scanning.

**c. PET**

A positron emission tomography (PET) scan is a diagnostic examination that uses small amounts of radioactive material to diagnose and determine the severity of a variety of diseases. It is an imaging test that uses a special dye that has radioactive tracers. These tracers are injected into a vein in the arm. Then the organs and tissues in the body will absorb this tracer. When highlighted under a PET scanner, the tracers helps to see how well the organs are working. The PET scan can measure the blood flow, oxygen use, glucose metabolism etc. A PET scan is typically an outpatient procedure.

## 3. NEED FOR ALZHEIMER DETECTION

The main objective is to detect the Alzheimer disease at an early stage at low cost, with high accuracy and with least radiation. Thereby it allows the patients family to take financial decisions related to the disease and to plan for future needs and care of the patients. In our proposed project, Early diagnosis of Alzheimer disease by using MRI is replaced with EEG signal for better accuracy, feasibility and efficiency[3].This method is only applicable for diagnosing Alzheimer disease and cannot be used for detecting any other diseases. The medications are applicable only during the early stage of disease. After the initial stages the detection will not be useful for providing medications. But the patient's family can plan for the future needs and care of the patient.

## 4. SYSTEM ARCHITECTURE

Figure 1 shows block diagram of proposed system. It includes,

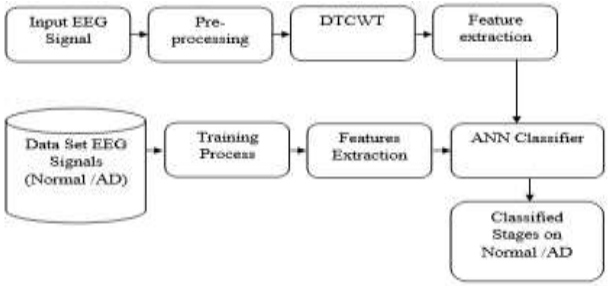


Fig 1.Block diagram

**1. Inputting EEG Signal**

12 test samples of EEG signals are inputted with the help of GUI guide.

**2. Pre-Processing unit**

This includes amplification, initial filtering of EEG signal artifact removal. Also A/D conversion is made. The raw EEG signal contains some noises that occur due to eye blinking, muscle artifacts and breathing deeply at the testing time. These noises affect the edge function of the EEG signals and the structure of waveform[3]. These noises are removed and the preprocessing is done by using a median filter.

**3. DTCWT**

The dual-tree complex wavelet transform (DTCWT) is a relatively recent enhancement to the discrete wavelet transform (DWT), with important additional properties: It is nearly shift invariant and directionally selective in two and higher dimensions. A low pass filter and three high pass filters are used to split the sub-bands based on frequency components.

**4. ANN**

Neural networks are predictive models loosely based on the action of biological neurons. The selection of the name "neural network" was one of the great PR successes of the Twentieth Century. It certainly sounds more exciting than a technical description such as "A network of weighted, additive values with nonlinear transfer functions".

**5. Database**

The raw EEG signal is collected from the physionet database[8].The database consists of 30 EEG signals of patients who are suffering from Alzheimer disease. The recording of EEG signal had done by using RMS (Recorders and Medicare systems Private Limited). EEG machine with 12 bits resolutions and sampling rate of 1024Hz. The electrodes (Referential Montages) are placed according to the International 10-20 systems and impedance is maintained below 10Mohms. EEG signal is converted into .mat file i.e. MATLAB file.

**6. Diagnosis**

Based on the output of ANN classifier we can detect whether the person is suffering from A/D or he is in the early stage of A/D which is called as Mild Cognitive Impairment [MCI][5].

## 5. METHODOLOGY

**Steps**

1. Choose an input EEG signal from the set of 12 signals
2. Preprocessing of the signal is done by using median filter to avoid noises.
3. Split the signals into sub bands by using dtcwt
4. Features like mean, median, variance, standard deviation, skewness, kurtosis are extracted[4].

5. 30 EEG signals are already stored in the data base which includes both normal as well as AD signal.

6. The 6 features of these signals are also extracted.

7. ANN classifier compares the features of input signal with the features of signals in database.

8. Output of classifier will detect whether the signal is normal, AD, or beginning of AD

## VI. RESULTS

After the classification stage, we can detect whether the person is suffering from Alzheimer or not. The ANN classifier classifies the signal into three stages.

(1)Normal case (2) Begin stage of Alzheimer (3) Advanced stage of Alzheimer

After testing 12 EEG test samples ,4 were detected as normal ,4 as the beginning stage of Alzheimer and the remaining 4 as the advanced stage of Alzheimer disease as shown in Figure 2,3 4 respectively.

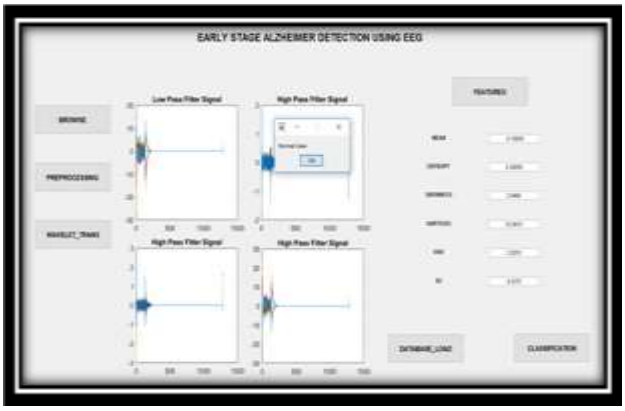


Figure 2. Normal case

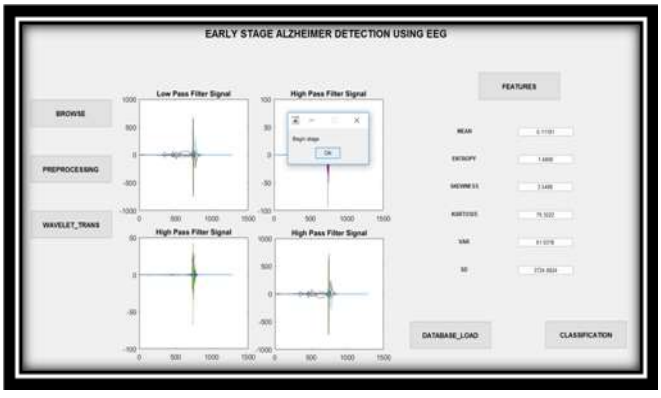


Figure 3. Beginning stage of Alzheimer


Figure 4. Advanced stage of Alzheimer

## 5. CONCLUSION AND FUTURE WORKS

In this way, we can use EEG as a means of diagnosis of Alzheimer disease. Various abnormalities are found in the EEG signals. Slowing of EEG signals, reduced complexity, perturbations in synchrony measures are some of the abnormalities found[7]. Various different features extraction methods as well as ANN classifier are used for early detection of the disease. Thus, EEG can be used as the inexpensive, convenient tool for early stage diagnosis of Alzheimer disease. In future, various different algorithms as well as classifiers such can be used for increasing the accuracy of diagnosis of the disease in early stage. Here the data's are obtained from data banks but in future real time signals may be used. Research Challenges includes the increase of accuracy up to 95% of EEG signal to detect the disease in the early stage, use of different classifiers for classification purpose & to remove the artifacts in EEG signal are some of them. In future, the above system can also be made portable[6].

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## REFERENCES

[1] P. Thakare and V. R. Pawar, "Alzheimer disease detection and tracking of Alzheimer patient," 2016 International Conference on Inventive Computation Technologies (ICICT), Coimbatore, 2016, pp. 1-4.

[2] Nilesh Kulkarni and Dr.V.K.Bairagi, "Diagnosis of Alzheimer Disease using EEG Signals", International Journal of Engineering Research & Technology (IJERT), Vol. 3 Issue 4, April – 2014

[3] M Kalaivani, V Kalaivani and Anusuya V Devi. Article: Analysis of EEG Signal for the Detection of Brain Abnormalities. IJCA Proceedings on International Conference on Simulations in Computing Nexus ICSCN(2):1-6, May 2014

[4] Jaeseung Jeong, "EEG dynamics in patients with Alzheimers disease",Clinical Neurophysiology, vol 115, pp 1490-1505,2004.

[5] G.Fiscon et al., "Alzheimer's disease patients classification through EEG signals processing," 2014 IEEE Symposium on Computational Intelligence and Data Mining (CIDM), Orlando, FL, 2014, pp. 105-112.

[6] R. Cassani, T. H. Falk, F. J. Fraga, P. A. Kanda and R. Anghinah, "Towards automated EEG-Based Alzheimer's disease diagnosis using relevance vector machines," 5th ISSNIP-IEEE Biosignals and Biorobotics Conference (2014): Biosignals and Robotics for Better and Safer Living (BRC), Salvador, 2014, pp. 1-6

[7] Al-Jumeily D., Iram S., Hussain A.J., Francois-Benois V., Fergus P. (2014) Early Detection Method of Alzheimer's Disease Using EEG Signals. In: Huang DS., Han K., Gromiha M. (eds) Intelligent Computing in Bioinformatics. ICIC 2014. Lecture Notes in Computer Science, vol 8590. Springer, Cham

[8] http://www.physionet.org/cgi-bin/atm/ATM